

Patent Claims

1. An apparatus for producing hydrogen, comprising
 - a) a reformer stage (1) for converting hydrocarbon gas and water into hydrogen and further reformer products such as carbon dioxide and carbon monoxide,
 - b) at least one catalyst stage (2), connected downstream from the reformer stage (1), for catalytic conversion of the carbon monoxide arising during the reforming process,
 - c) a methanization stage (3), which is connected downstream from the catalyst stage (2) and has axial flow, to which a flow guiding housing (4) for a coolant, which extends in the axial flow direction, is assigned,
characterized in that
the flow guiding housing (4) has at least two, preferably three or more cooling zones (5, 6, 7, 8) having different cooling effects situated one behind another in the axial direction.
2. The apparatus for producing hydrogen according to claim 1,
characterized in that
the coolant may be supplied separately to each of the cooling zones (5, 6, 7, 8).
3. The apparatus for producing hydrogen according to claim 2,
characterized in that

the cooling zones (5, 6, 7, 8) enclose the methanization stage (3) like annular chambers situated one after another or, with a hollow-cylindrical implementation of the methanization stage (3), are enclosed thereby.

4. The apparatus for producing hydrogen according to claim 2,
characterized in that
each cooling zone (5, 6, 7, 8) has at least one coolant supply connection (10) and one coolant removal connection (11).
5. The apparatus for producing hydrogen according to claim 2,
characterized in that
each cooling zone (5, 6, 7, 8) may have coolant flow through it alternately in parallel flow or counterflow to the methanization stage (3).
6. The apparatus for producing hydrogen according to claim 2,
characterized in that
different coolants, which are preferably temperature controlled differently, may be supplied to the cooling zones (5, 6, 7, 8).
7. The apparatus for producing hydrogen according to claim 1,
characterized in that
the cooling zones (5, 6, 7, 8) situated one behind another in the axial direction are directly hydraulically connected to one another, but have different

flow cross-sections, the cooling zones (5, 6, 7, 8) preferably alternately having stepped flow cross-sections or continuously changing flow cross-sections in the axial direction and the cooling zones (5, 6, 7, 8) preferably being able to have coolant flow through them alternately in parallel flow or counterflow to the methanization stage (3).

8. The apparatus for producing hydrogen according to claim 1,
c h a r a c t e r i z e d i n t h a t
the reformer stage (1), preferably the catalyst stage (2), and preferably the methanization stage (3) are implemented as hollow cylinders.
9. The apparatus for producing hydrogen according to claim 8,
c h a r a c t e r i z e d i n t h a t
the reformer stage (1), the catalyst stage (2), and the methanization stage (3), if implemented as hollow cylinders, are situated one behind another to define a continuous annular chamber in the axial flow direction.
10. The apparatus for producing hydrogen according to claim 8,
c h a r a c t e r i z e d i n t h a t
the cooling zones (5, 6, 7, 8), if the methanization stage (3) is implemented as a hollow cylinder, are alternately situated inside and/or outside the methanization stage (3).